

# Cihan Okay

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## Biographical Data

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**Name:** Cihan Okay

**Citizenship:** Turkish (Permanent resident of Canada)

**Date/Place of birth:** November 9, 1985 / Istanbul, Turkey

## Current Position

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2020- Assistant Professor, Department of Mathematics  
Bilkent University, Ankara, Turkey

## Past Positions

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2017-2020 Postdoctoral fellow, Stewart Blusson Quantum Matter Institute  
The University of British Columbia, Vancouver, Canada  
Group leader: Robert Raussendorf

2014-2017 Postdoctoral fellow, Department of Mathematics  
Western University, London, Canada  
Advisor: John F. Jardine

## Education

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2009-2014 Ph.D. Mathematics  
The University of British Columbia, Vancouver, Canada  
Dissertation: Homotopy colimits of classifying spaces of finite abelian groups  
Advisor: Alejandro Adem

2007-2009 M.Sc. Mathematics  
Bilkent University, Ankara, Turkey  
Thesis: The monomial Burnside functor  
Advisor: Laurence Barker

2003-2007 B.S. Physics  
Bilkent University, Ankara, Turkey  
Senior Project: Non-rotating black holes  
Advisor: Metin Gürses

## Awards

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2020-2023 Air Force Office of Scientific Research, \$130K/year to support the project  
*Topology of quantum resources: Homotopical methods in resource theories for quantum information and quantum computing*

## Publications

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1. *Quasi-exact quantum computation* with Dong-Sheng Wang, Guanyu Zhu, Raymond Laflamme, Phys. Rev. Research 2, 033116 (2020)
2. *Phase space simulation method for quantum computation with magic states on qubits* with Robert Raussendorf, Juani Bermejo-Vega, Emily Tyhurst, Michael Zurel, Phys. Rev. A 101, 012350 (2020)
3. *Homotopical approach to quantum contextuality* with Robert Raussendorf, Quantum 4, 217 (2020)

4. *On the mod- $\ell$  homology of the classifying space for commutativity* with Ben Williams, Algebraic & Geometric Topology 20-2 883-923 (2020)
5. *A computationally universal phase of quantum matter* with Robert Raussendorf, Dong-Sheng Wang, David T. Stephen, Hendrik Poulsen Nautrup, Phys. Rev. Lett. 122, 090501 (2019)
6. *The cohomological and the resource-theoretic perspective on quantum contextuality: common ground through the contextual fraction* with Emily Tyhurst, Robert Raussendorf, Quantum Information and Computation 18, 1272-1294 (2018)
7. *Dimension functions for spherical fibrations* with Ergun Yalcin, Algebraic & Geometric Topology 18.7 3907-3941 (2018)
8. *Spherical posets from commuting elements*, Journal of Group Theory, ISSN 1433-5883 (2018)
9. *Topological proofs of contextuality in quantum mechanics* with Sam Roberts, Stephen D. Bartlett, Robert Raussendorf, Quantum Information and Computation 17, 1135-1166 (2017)
10. *Equivalence between contextuality and negativity of the Wigner function for qudits* with Nicolas Delfosse, Juan Bermejo-Vega, Dan E. Browne, Robert Raussendorf, New J. Phys. 19 123024 (2017)
11. *Contextuality as a resource for models of quantum computation on qubits* with Juan Bermejo-Vega, Nicolas Delfosse, Dan E. Browne, Robert Raussendorf, Phys. Rev. Lett. 119, 120505 (2017)
12. *Contextuality and Wigner function negativity in qubit quantum computation* with Robert Raussendorf, Dan E. Browne, Nicolas Delfosse, Juan Bermejo-Vega, Phys. Rev. A 95, 052334 (2017)
13. *Colimits of abelian groups*, Journal of Algebra Volume 443, Pages 1-12 (2015)
14. *Homotopy colimits of classifying spaces of abelian subgroups of a finite group*, Algebraic & Geometric Topology 14 2223-2257 (2014)

## Preprints

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1. *Commutative  $d$ -Torsion  $K$ -Theory and Its Applications*, arXiv:2006.07542 (2020)
2. *A hidden variable model for universal quantum computation with magic states on qubits* with Michael Zurel, Robert Raussendorf, arXiv:2004.01992, to appear in *Physical Review Letters* (2020)
3. *Commutative simplicial bundles* with Pal Zsamboki, arXiv:2001.04052, to appear in *Homology, Homotopy and Applications* (2020)
4. *Classifying space for quantum contextuality* with Daniel Sheinbaum, arXiv:1905.07723, to appear in *Annales Henri Poincaré* (2020)

## Patents

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1. *Classical simulation of quantum computation using a universal classical key*, Inventors: Robert Raussendorf, Michael Owen Zurel, Cihan Okay  
U.S. Provisional Patent Application No.: 63/004,701, Filed: April 3, 2020

## Conference/Seminar Talks

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1. "Homotopical approach to quantum contextuality", Mathematics Days IV, Istanbul Center for Mathematical Sciences (2020)
2. "Commutative simplicial bundles and their classifying spaces", Algebraic Geometry and Differential Topology seminar, Alfréd Rényi Institute of Mathematics (2020)
3. "Stable homotopy and quantum contextuality", Algebraic Structures in Quantum Computation (ASQC4) Workshop, UBC (2020)

4. "Applications of Homotopy Theory in Quantum Computation", Mathematics Seminars, Koc University (2020)
5. "Applications of Homotopy Theory in Quantum Computation", Mathematics Seminars, Bogazici University (2020)
6. "Classifying space for quantum contextuality", Contextuality as a Resource in Quantum Information, University of Oxford (2019)
7. "Homotopical approach to contextuality", 15th International Conference on Quantum Physics and Logic (2019)
8. "Topology of contextuality", CMS Summer Meeting Special Session on Mathematical Techniques for Analysing Quantum Structures and Materials, University of Regina (2019)
9. "On the mod- $\ell$  homotopy type of the classifying space for commutativity", CMS Summer Meeting Special Session on Topology, University of Regina (2019)
10. "On the mod- $\ell$  homotopy type of the classifying space for commutativity", Topology seminar, Bilkent University (2019)
11. "Homotopical approach to contextuality", Quantum Contextuality in Quantum Mechanics and Beyond, Prague (2019)
12. "On the mod- $\ell$  homotopy type of the classifying space for commutativity", Algebra seminar, Alfréd Rényi Institute of Mathematics (2019)
13. "Cohomological framework for contextuality", Discrete phase space methods for quantum fault-tolerance, Physics Center Bad Honnef (2018)
14. "Covariance of Wigner function", Algebraic Structures in Quantum Computation, University of British Columbia (2018)
15. "A classifying space for commutativity", Antalya Algebra days, Nesin Mathematics Village (2018)
16. "Dimension functions for spherical fibrations", Topology seminar, Bilkent University (2018)
17. "Spherical posets from commuting elements", Topology seminar, University of British Columbia (2018)
18. "Applications of classifying spaces in quantum computation", Topology seminar, Bilkent University (2017)
19. "Applications of classifying spaces in quantum computation", Applied Algebraic Topology, Hokkaido University (2017)
20. "Topological proofs of contextuality in quantum mechanics", Algebraic Structures in Quantum Computation, University of British Columbia (2017)
21. "Filtrations of classifying spaces", AMS Special Session on Representation Spaces and Toric Topology, City University of New York (2017)
22. "Spherical posets from commuting elements", Geometry and Topology seminar, University of Western Ontario (2016)
23. "Spherical posets from commuting elements", Topology seminar, Bilkent University (2016)
24. "Cohomology and contextuality", Algebraic Structures in Quantum Computation, University of British Columbia (2016)
25. "Filtrations of classifying spaces", Topology seminar, University of Rochester (2016)
26. "Cohomology of metacyclic groups", Algebra seminar, University of Western Ontario (2016)

27. "Introduction to the Coq proof assistant", Homotopy theory seminar, University of Western Ontario (2016)
28. "Towards a refinement of the Bloch-Kato conjecture", Geometry and Topology seminar, University of Western Ontario (2015)
29. "Filtrations of classifying spaces", Equivariant homotopy and infinity categories, Bogazici University (2015)
30. "Towards a refinement of the Bloch-Kato conjecture", Topology seminar, Bilkent University (2015)
31. "Hopf invariant one problem", Homotopy theory seminar, University of Western Ontario (2015)
32. "Homotopy groups of the circle (Homotopy type theory)", Homotopy theory seminar, University of Western Ontario (2014)
33. "Filtrations of classifying spaces", Geometry and Topology seminar, University of Western Ontario (2014)
34. "Nilpotent groups and colimits", Algebra seminar, University of Western Ontario (2014)
35. "Homotopy Colimits of Classifying Spaces of Abelian Groups", Geometry and Topology seminar, University of Western Ontario (2014)
36. "Homotopy colimits of classifying spaces of abelian groups", Topology seminar, University of British Columbia (2013)
37. "Homotopy colimits of classifying spaces of finite groups and  $K$ -theory", Topology seminar, Bilkent University (2012)
38. "Homotopy colimits of classifying spaces of finite groups and  $K$ -theory", Topology seminar, University of British Columbia (2012)

## Poster Presentations

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1. Poster "Homotopical approach to quantum contextuality", Southwest Quantum Information and Technology (SQuInT) Workshop, Eugene (2020)
2. Poster "Cohomological and resource-theoretic perspective on quantum contextuality" and "A computationally universal phase of quantum matter", 22nd Annual Conference on Quantum Information Processing (2019)
3. Poster "Cohomological and resource-theoretic perspective on quantum contextuality", 15th International Conference on Quantum Physics and Logic (2018)

## Seminar/Workshop Organization

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Fall 2020	Topology Seminar (weekly), Bilkent
June 22-24 2020	Fourth Workshop on Algebraic Structures in Quantum Computation, co-organized by Robert Raussendorf, UBC
2019-2020	Quantum Information Meetings (weekly) of Robert Raussendorf's Group, UBC
Fall 2019	Reading seminar (weekly) on <i>Classification of symmetry-protected topological phases</i> , UBC
Fall 2019	Reading seminar (weekly) on <i>Introduction to Stable homotopy theory</i> , UBC
Fall 2018- Winter 2019	Reading seminar (weekly) on <i>Topological quantum computation</i> , UBC

## Teaching Experience

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Fall 2020	Math 101-8: Calculus I, Bilkent
Winter 2017	Mathematics 1225B: Methods of Calculus, UWO
Fall 2016	Math 9144A: Homological algebra, UWO
Winter 2016	Mathematics 1225B: Methods of Calculus, UWO
Summer 2015	Calculus 1000A: Calculus I, UWO
Winter 2015	Mathematics 1225B: Methods of Calculus, UWO
Fall 2014	Calculus 1000A: Calculus I, UWO
Summer 2013	Math 105-922: Integral Calculus with Applications to Commerce and Social Sciences, UBC
Summer 2012	Math 105-922: Integral Calculus with Applications to Commerce and Social Sciences, UBC

## Students Supervised

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Fall 2020	Oussama Amir, Undergraduate senior project, <i>Algebraic aspects of symmetric informationally complete measurements</i> , Bilkent
February 2020	Daniel Sheinbaum, Ph.D, <i>Applications and Connections between Twisted Equivariant K-theory, Quantum Mechanics and Condensed Matter</i> , co-supervised by Alejandro Adem, UBC

## Service to the Profession

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1. Evaluation of workshop proposal(s) submitted to Banff International Research Station (BIRS)
2. Reviewer for the Research in the Mathematical Sciences (RMSB) journal

## Fellowships/Scholarships

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2020-2021	Pacific Institute for the Mathematical Sciences (PIMS) Collaborative Research Groups Postdoctoral Fellowship (declined)
2009-2013	UBC Four Year Doctoral Fellowship & International Partial Tuition Scholarship
2007-2009	Graduate Scholarship for M.Sc., The Scientific and Technological Research Council of 2007-2009 Turkey
2003-2007	Full scholarship at Bilkent University

## Other Information

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Computer	GAP (Groups, Algorithms, Programming), Coq, Java
Language	Native Turkish, Fluent English
Volunteer Work	Vancouver International Film Festival, Vancouver Guitar Society

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For further information please contact me directly.

Last update: November 11, 2020